Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Brief Report

Occupational COVID-19 exposures and secondary cases among healthcare personnel

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A B S T R A C T

Throughout the COVID-19 pandemic, healthcare personnel (HCP) have been at high risk of exposure to SARS-CoV-2, both from patients and co-workers. This paper summarizes occupational exposures to SARS-CoV-2 and secondary cases among HCP at a large health system. Key findings indicate that transmission of COVID-19 to HCP is low, especially with close adherence to PPE guidelines, but lapses in infection prevention practices, including dining together and omitting eye protection during patient care, especially at times when COVID-19 is circulating widely in the community increase the risk of exposure and subsequent transmission to HCP.

BACKGROUND

During the Coronavirus Disease of 2019 (COVID-19) pandemic, while much of the population was able to limit exposure to non-household members, healthcare personnel (HCP) continued to be at exposure risk. Despite national guidelines and internal protocols that enhanced safety precautions, workplace exposures continued to occur and lead to secondary cases among HCP.[1] This report details occupational exposures to COVID-19 within a large health system comprised of more than 30,000 employees.

MATERIAL AND METHODS

A retrospective cohort study was conducted from June 1 to December 31, 2020. This time-period was chosen for consistency, as exposure definitions, personal protective equipment (PPE) recommendations, and isolation guidelines changed frequently from March to May 2020. Data were obtained from an electronic exposure management program used to identify and track exposed HCP. HCP involved in workplace COVID-19 exposures are stratified by job class, exposure source (patient vs employee), and exposure risk tier as outlined by the Centers for Disease Control and Prevention (CDC). Employees who developed COVID-19 infection following occupational exposure were deemed secondary cases and stratified as above and by severity of illness. The exposure tiers are as follows.[2]

Tier 1: The case did not wear a cloth face covering or facemask and the HCP was unmasked or was masked but did not wear eye protection and was within 6 feet of the case for at least 15 minutes.

Tier 2: The HCP was in contact with an aerosol-generating procedure (AGP) and did not wear an N95 respirator (or equivalent), eye protection, gown and gloves.

Following an exposure event, relevant department managers were notified via e-mail and identified exposed employees based on exposure definitions provided by Infection Prevention. Exposed employees were assigned an exposure tier, and when data were missing, tier was categorized as “unknown.” Once the event was created, exposed employees received e-mail instructions to contact employee health services for follow-up and testing. Institutional policy required exposed employees be tested four to seven days

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Table 1
Employees involved in occupational COVID-19 exposures by role, tier, and subsequent secondary cases

	RN	MD	APP	PCT	EVS	RT	MA	Other ancillary	Office/Admin	Total
Number of employees by role* n, (% of total)	7,289 (23.7%)	2,339 (7.6%)	912 (3.0%)	1,300 (4.2%)	747 (2.4%)	302 (1.0%)	961 (3.1%)	6,787 (22.1%)	10,080 (32.8%)	30,717
Source: Patient										
Number exposed n, (% of total)	499 (44.2%)	217 (19.2%)	35 (3.1%)	160 (14.2%)	22 (2%)	76 (6.7%)	5 (0.4%)	114 (10.1%)	0 (0%)	1128 (100%)
Tier 1 n, (% of number exposed)	244 (48.9%)	35 (16.1%)	9 (25.7%)	78 (48.8%)	11 (50%)	3 (3.9%)	1 (20%)	53 (46.5%)	0 (0%)	434 (38.5%)
Tier 2 n, (% of number exposed)	131 (26.3%)	39 (18%)	13 (37.1%)	35 (21.9%)	1 (4.5%)	56 (73.7%)	0 (0%)	28 (24.6%)	0 (0%)	303 (26.9%)
Tier Unknown n, (% of number exposed)	124 (24.8%)	143 (65.9%)	13 (37.1%)	47 (29.4%)	10 (45.5%)	17 (22.4%)	4 (80%)	33 (28.9%)	0 (0%)	391 (34.7%)
Secondary cases n, (% of number exposed)	19 (3.8%)	2 (0.9%)	1 (2.9%)	13 (8.1%)	1 (4.5%)	1 (1.3%)	0 (0%)	2 (1.8%)	0 (0%)	39 (3.5%)
*Source: Employee***										
Number exposed n, (% of total)	388 (31.6%)	332 (27.0%)	29 (2.4%)	64 (5.2%)	6 (0.5%)	16 (1.3%)	33 (2.7%)	324 (26.4%)	37 (3.0%)	1229 (100%)
Secondary cases n, (% of number exposed)	15 (3.9%)	1 (0.3%)	2 (6.9%)	1 (1.6%)	2 (33.3%)	0 (0%)	0 (0%)	13 (4.0%)	1 (2.7%)	35 (2.8%)

APP, advanced practice provider; *EVS*, environmental services; *MA*, medical assistant (ambulatory); *MD*, medical doctor; *PCT*, patient care technician; *RN*, registered nurse; *RT*, respiratory therapist.
*The number of employees by role excludes non-employees (eg, medical students, residents, fellows, contractors).
**All exposures with an employee as the source were considered Tier 1 exposures.

post-exposure and be excluded from work if positive or if symptoms developed.

RESULTS

Between June and December 2020, 2,357 employees were involved in occupational COVID-19 exposures, with 1,655 (70.2%) Tier 1 exposures, 311 (13.2%) Tier 2, and 391 (16.6%) in an unknown tier (Table 1). Of the 2,357, 1,128 (47.9%) were exposed to patients and 1,229 (52.1%) to other employees. The number of exposed employees was highest in June (n = 440; 18.7%), September (n = 374; 15.9%), October (n = 533; 22.6%), and November (n = 448; 19.0%). This coincided with community levels of virus transmission. RNs accounted for the majority of HCP exposed to both patients (n = 499, 44.2%) and employees (n = 388, 31.6%).

74 (3.1%) HCP involved in workplace exposures subsequently tested positive within 14 days of the exposure (Table 2). More secondary cases occurred from exposure to patients versus employees (n = 39, 52.7% vs. n = 35, 47.3%, respectively). Most secondary cases (n = 54, 73%) were involved in Tier 1 exposures. Of 39 secondary cases

Table 2
Month, location, severity of illness, and evaluation of 74 secondary cases involved in occupational COVID-19 exposures

		June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total n (% of cumulative total)
Percentage positivity of COVID-19 Tests in Illinois by month[4] (peak 7-day moving average)		6.5%	3.9%	4.4%	4.6%	7.8%	13.2%	10.6%	N/A
Disease Severity n, (% of monthly total)	Asymptomatic	4 (50%)	3 (60%)	0 (0%)	1 (7.7%)	1 (4.4%)	4 (22.2%)	0 (0%)	13 (17.6%)
	Symptomatic (not requiring hospitalization)	4 (50%)	2 (40%)	4 (100%)	11 (84.6%)	21 (91.3%)	14 (77.8%)	3 (100%)	59 (79.7%)
	Symptomatic (requiring hospitalization)	0 (0%)	0 (0%)	0 (0%)	1 (7.7%)	1 (4.4%)	0 (0%)	0 (0%)	2 (2.7%)
Exposure Source type n, (% of monthly total)	Patient	4 (50%)	3 (60%)	2 (50%)	8 (61.5%)	12 (52.2%)	9 (50%)	1 (33.3%)	39 (52.7%)
	Employee	4 (50%)	2 (40%)	2 (50%)	5 (38.5%)	11 (47.8%)	9 (50%)	2 (66.7%)	35 (47.3%)
Exposure tier n, (% of monthly total)	Tier 1	5 (62.5%)	4 (80%)	4 (100%	8 (61.5%)	16 (70.0%)	14 (77.8%)	3 (100%)	54 (73.0%)
	Tier 2	1 (12.5%)	1 (20%)	0 (0%)	4 (30.8%)	7 (30.4%)	3 (16.7%)	0 (0%)	16 (21.6%)
	Tier Unknown	2 (25%)	0 (0%)	0 (0%)	1 (7.7%)	0 (0%)	1 (5.6%)	0 (0%)	4 (5.4%)
Most common exposure reasons n, (% of total)	Eye protection omitted during routine patient care	0 (0%)	2 (40%)	1 (25%)	3 (23.1%)	1 (4.3%)	4 (22.2%)	1 (33.3%)	12 (16.2%)
	Eye protection omitted during AGP	0 (0%)	0 (0%)	0 (0%)	1 (7.7%)	3 (13.0%)	1 (5.6%)	0 (0%)	5 (6.8%)
	N95 omitted during AGP	0 (0%)	0 (0%)	0 (0%)	1 (7.7%)	1 (4.3%)	0 (0%)	0 (0%)	2 (2.7%)
	Ate lunch with positive employee	0 (0%)	0 (0%)	0 (0%)	2 (15.4%)	2 (8.6%)	8 (44.4%)	2 (66.7%)	14 (18.9%)
Occupational setting n, (% of total)	Emergency Department	0 (0%)	0 (0%)	2 (50%)	1 (7.7%)	2 (8.7%)	0 (0%)	3 (100%)	8 (10.8%)
	Inpatient	8 (100%)	2 (40%)	2 (50%)	12 (92.3%)	15 (65.2%)	17 (94.4%)	0 (0%)	56 (75.7%)
	Ambulatory	0 (0%)	3 (60%)	0 (0%)	0 (0%)	5 (21.7%)	1 (5.6%)	0 (0%)	9 (12.2%)
	Office/administrative	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.3%)	0 (0%)	0 (0%)	1 (1.4%)
Confirmed exposure outside of work n, (% of total)		1 (12.5%)	1 (20%)	0 (0%)	0 (0%)	3 (13.0%)	1 (5.6%)	1 (33.3%)	7 (9.5%)
Monthly total n, (% of total secondary cases)		8 (10.8%)	5 (6.8%)	4 (5.4%)	13 (17.6%)	23 (31.1%)	18 (24.3%)	3 (4.1%)	Cumulative Total = 74

exposed to patients, 19 (48.7%) were involved in Tier 1 exposures, and of these, 12 (63.1%) reported not wearing eye protection while interacting with an unmasked infected patient, while 7 (36.8%) did not specify their exposure criteria. Of the remaining 20 secondary cases exposed to patients, 16 (80%) were involved in Tier 2 exposures and 4 (20%) had an unknown exposure. Of these 16, 5 (31.3%) specified that they did not wear eye protection while performing AGPs, 2 (12.5%) wore a procedure mask rather than an N95 respirator, and 9 (56.3%) did not specify which PPE was omitted. Of 35 secondary cases exposed to infectious coworkers, 14 (40%) ate a meal near the source employee, and 25 (60%) did not specify exposure details. Among secondary cases, 59 (79.9%) experienced mild to moderate illness, 13 (17.6%) were asymptomatic, and 2 (2.7%) required hospitalization. No cases resulted in death.

DISCUSSION

These results highlight a few key findings. Only a small proportion of employees involved in occupational exposures tested positive for SARS-CoV-2 within 14 days following exposure. More employees were exposed via coworkers than patients. Among secondary cases, many employees reported having dined with or spent more than 15 minutes near an infectious employee without wearing masks. For those exposed to patients, eye protection was commonly omitted while caring for patients not known to be infectious, emphasizing the importance of protecting all mucous membranes, including eyes, while caring for patients even if COVID-19 infection is not suspected.[3]

Another important finding is the large increases in exposed employees and subsequent secondary cases from September through November 2020. We hypothesize this is due to two main factors. First, because these increases coincide with a COVID-19 surge in the Midwest, staff would likely have interacted with more patients and community members with COVID-19 during this time. Second, many employees were observed not complying with PPE requirements, which may have been due to several factors, including: (1) fatigue with safety requirements; (2) perception that COVID-19 was decreasing in the community; (3) belief that few HCP had tested positive for COVID-19 up to that point and/or; (4) general lack of understanding of the importance of certain PPE, particularly eye protection.

This study has several limitations. First, data were subject to self-reporting bias. Some employees may not have wanted to report that they failed to comply with PPE and other safety requirements, and thus were not identified as exposed or their risk factors were not fully captured. Second, some employees could not recall the PPE worn in specific instances, especially when having to look back more than a few days, and may have been deemed exposed out of an abundance of caution.

During times when SARS-CoV-2 is circulating widely in the community, it is critical to operate under the assumption that anyone outside of one's own household could be infectious. Mitigation factors must include widespread testing and adherence to isolation precautions and PPE guidelines including maintaining physical distancing when masks must be removed around other employees. Close adherence to CDC guidelines is crucial to safely care for patients with COVID-19 and to prevent virus transmission among healthcare workers.

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